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Composition induced structural evaluation in BO₃-3, PO₄-3 and SO₄-2 substituted CaMoO₄:Dy³⁺ phosphors for application in White-Light LEDs

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A series of novel white light emitting CaMoO₄:Dy³⁺ (1.0 mol %) phosphors substituted with different anionic groups (BO₃-3, PO₄-3 and SO₄-2) were prepared using a high temperature solid state reaction method. The effects of anionic substitution on the crystalline structure and photoluminescence (PL) properties of the CaMoO₄:Dy³⁺, CaMoO₄-BO₃:Dy³⁺, CaMoO₄-PO₄:Dy³⁺ and CaMoO₄-SO₄:Dy³⁺ phosphors were investigated. The X-ray diffraction (XRD) patterns confirmed that the phosphors to be crystallized in a pure scheelite-type tetragonal structure. The field emission scanning electron microscopy (FE-SEM) images showed that the particles were agglomerated together and they had no definite size. The chemical composition analyses and the electronic states were analyzed using the energy-dispersive X-ray spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS) respectively. The Fourier transform infrared spectroscopy (FTIR) data supplemented both the XRD and EDS data by confirming that the stretching mode frequencies were all related to BO₃-3, PO₄-3 and SO₄-2 except a few absorption peaks ascribed to atmospheric moisture and hydrocarbons. The band gaps measured from the ultraviolet visible spectroscopy (UV-Vis) data were shown to vary for the different anionic group systems. The excitation spectra of the phosphors were characterized by broadband extending from 250 to 500 nm. Upon near-UV excitation, the phosphor emits intense blue and yellow light with a weak red bands, which originated from 4F_{9/2}→6H_{15/2}, 6H_{13/2}, 6H_{11/2} transitions of Dy³⁺ ion respectively. Furthermore, high intensity white light color emission was achieved by substitution of different anionic groups (BO₃-3, PO₄-3 and SO₄-2) into the CaMoO₄:Dy³⁺ phosphors. Among all the studied phosphors, the CaMoO₄-SO₄:Dy³⁺ phosphor showed the strongest PL emission compared to all other phosphors suggesting that it is a promising potential candidate for red emission in the near UV excited white LED applications.

Apply to be considered for a student award (Yes / No)?

No

Level for award (Hons, MSc, PhD, N/A)?

N/A

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